A.41 ADVANCED INFORMATION SYSTEMS TECHNOLOGY

NOTICE: Amended April 11, 2014. This Amendment releases the final text for A.41, Advanced Information Systems Technology, which replaces the placeholder text provided on ROSES 2014 release in its entirety. Notices of Intent are requested by May 21, 2014; proposals are due July 11, 2014.

1. Introduction

The Earth Science Technology Office (ESTO) manages the development of advanced technologies and applications that are needed for cost-effective missions, and plays a major role in shaping Earth science research and application programs of the future. These important technology investments, made external to the operations and development activities of core science functions, enable promising scientific and engineering concepts to be explored. By coordinating across missions and science focus areas to define technology needs of the NASA's Earth Science Division, ESTO ensures its technology programs create an effective balance of investments in order to advance important technology development.

Information technology advances play a critical role in collecting, handling, and managing very large amounts of data and information in space, in the air, and on the ground. The objectives of the Advanced Information Systems Technology (AIST) program are to identify, develop, and demonstrate advanced information system technologies that:

- Reduce the risk, cost, size, and development time for Earth science space-based, airborne, and ground-based information systems,
- Increase the accessibility and utility of science data, and
- Enable new observations and information products.

The AIST program is designed to bring information system technologies to a Technology Readiness Level (TRL)[1] that allows integration into existing or future technology or science research and development programs, or infusion into existing or planned capabilities to enable timely and affordable delivery of information to users. The AIST program accepts technology development at various stages of maturity and advances the TRL through appropriate risk reduction activities such as requirements analysis, conceptual design, prototypes, and proof-of-concept demonstrations.

The overarching NASA Earth Science implementation plan is defined in the *2010 Climate-Centric Architecture*[2] document. Consistent with the plan, the AIST program has the responsibility for providing advanced technologies to enable science measurements, make use of data for research, and facilitate practical applications for societal benefit by directly supporting each of the core functions within NASA's Earth Science Division:

[1] This solicitation makes use of the software TRLs defined at http://nodis3.gsfc.nasa.gov/displayDir.cfm?t=NPR&c=7123&s=1B

[2] http://science.nasa.gov/media/medialibrary/2010/07/01/Climate_Architecture_Final.pdf

- Research and Analysis (R&A): Pursuant to the goals of the U.S. Global Change Research Program[3], the R&A function implements a portfolio of focused projects which answer key questions related to the understanding the full complexity of the Earth system, along with prediction of climate change and potential adaptation and mitigation strategies. A key challenge is for scientists to make use of comprehensive global observations from satellites, aircraft, and from the output of numerical models over long periods of time at unprecedented spatial and temporal resolutions. Investments in novel and innovative information technologies are necessary for scientists to make effective use of the unprecedented amount of information available such that an understanding of the Earth as a complete system may be realized.

- Flight: NASA's spaceborne instruments provide the coverage and sampling of key climate parameters necessary for integrated Earth system science research. Plans for future missions are influenced by two foundational documents: the 2007 National Research Council (NRC) Decadal Survey[4] and the successor 2012 Midterm Assessment Report[5]. These documents describe the NRC's recommendation for a broad portfolio of new, focused missions along with the continuity of key climate measurements that are not being made by partner agencies. Within the Earth Science Division, a new emphasis is being placed upon some of the more novel approaches discussed in the midterm assessment, including next-generation airborne capabilities, hosted payloads on commercial spacecraft, small satellites, the International Space Station, and the flight of multiple sensors in formation. The Earth Observing System Data and Information System (EOSDIS) that provides science data is evolving to meet the challenging needs of the wide community of users for NASA's Science Mission Directorate. Advanced information technology will play a key role in designing and enabling recommended missions and supporting data systems, as well as reducing the cost of future systems.

- Applied Sciences: The overarching purpose of the Applied Sciences function is to leverage NASA Earth science satellite measurements and new scientific knowledge to provide innovative and practical uses for public and private sector organizations. The program also enables near-term uses of Earth science knowledge, discovers and demonstrates new applications, and facilitates adoption of applications by non-NASA stakeholder organizations. Information technology investments are key to the Applied Sciences goals of enhancing applications research, increasing collaborations, and accelerating applications.

2. Proposal Research Topics

Key technical themes being solicited are grouped into three core topics (refer to Section 2.1): Operations Technologies, Computational Technologies, and Data-Centric Technologies. Additionally there are three special subtopics being solicited to address more specific needs of the Earth Science Division (refer to Section 2.2). For each area the investments are intended to reduce the risk and cost of evolving NASA information systems to support future Earth

[3] http://www.globalchange.gov

[4] http://www.nap.edu/catalog.php?record_id=11820

[5] http://www.nap.edu/catalog.php?record_id=13405

observations and to transform those observations into Earth information. The topics encompass both hardware and software for space-based, airborne, or ground-based systems.

To respond to the solicitation proposers are required to identify exactly one core topic area to identify their proposal theme. If a proposer desires to address a special subtopic then the subtopic should be selected in addition to the core topic. Proposers are requested to select the topic(s) on the NSPIRES cover page, or to explicitly name the topics in the abstract if the proposal is submitted through Grants.gov.

Proposers are required to provide an entry TRL estimate with brief justification in their proposals. Entry TRL for this solicitation is from 2 through 5.

For any of the topics, facilities needed for computation, testing, verification, or validation of components, subsystems, and/or systems can be included and priced as an integral part of a proposed technology effort, but should not be submitted as a stand-alone proposal. If any special purpose equipment is needed the proposers should identify how such equipment would be acquired and how it would contribute to the overall effort.

2.1 Core Topics

2.1.1 Operations Technologies

Operations information systems technologies broadly support the future challenges of operating NASA's Earth Science space-based, airborne, or ground-based systems. Uninhabited Aerial Vehicles (UAVs), small satellites, and ground-based *in situ* sensor systems are poised to advance how scientific observations are performed given their flexibility, cost, and time to deployment. Innovations are required in how these kinds of systems are operated and how their data are acquired and disseminated. These assets will be globally distributed and may contribute to a sensor web[6], which would rely on real-time data acquisition and control for science analysis and decision support applications.

Example technology areas and challenges include, but are not limited to:

- Reusable and rapidly re-configurable ground data systems operational technologies.
- Technologies for automated real-time operations.
- Tools for operations planning, scheduling, data acquisition, product distribution, and/or archiving from distributed and high data rate observations.
- Technologies for efficient operation and control of small satellites, UAVs, and science campaigns.
- Technologies for coordinated operation and data management of distributed, heterogeneous, and dynamic Earth observing assets (e.g., sensor webs and/or distributed mission operations), including small satellites, airborne platforms, UAVs, and in-situ sensors and instruments, for science objectives.

[6] ESTO defines a "sensor web" to be a coherent set of heterogeneous, loosely-coupled, distributed nodes interconnected by a communications fabric that can collectively behave as a single dynamically adaptive and reconfigurable observing system. For more details refer to http://esto.nasa.gov/sensorwebmeeting/files/aist_sensor_web_meeting_report_2007.pdf .

- Technologies for supporting generation of "low latency" data products.
- Operational capabilities specific to aircraft missions, such as goal-directed planning, model driven re-planning, vehicle health and monitoring, and on-board processing to support such capabilities.
- Operational capabilities specific to small satellites such as processing, compression, storage, downlink, autonomous operations, and attitude determination and control to meet operational pointing requirements.

2.1.2 Computational Technologies

This topic refers to information systems technologies that operate directly on Earth Science data produced by sensors, either real or simulated, in order to improve or enhance:

- Information extracted from the data stream or model outputs
- Measurements to be acquired by a new mission or science campaign
- Researchers' tools for analytics

The Computational Technologies topic includes innovations in computer architectures, computing hardware, algorithms, and novel approaches to software programming and software engineering. It also includes software developments that improve computing performance or provide new or improved functionality. Technologies in this category are intended to improve the science value of the data at minimal cost. As a consequence, they have the potential for improving the overall cost effectiveness of a mission or science research effort and reduce the end product latency. Example technology areas include (but are not limited to):

- Data mining and visualization to enable analysis (e.g., data immersion approaches to enable real-time interaction with the models, and visualization of highly complex systems).
- Data exploration that significantly advances state of the art in Earth Science research.
- Enhancements of workflows, automation, data accessibility, multiple computing paradigms, and collaboration.
- Techniques to exploit specialized processing units or accelerators and cloud computing technologies for large-scale on-demand data processing, mining, and distribution.
- Tools to manage the validation and assessment of model data inter-comparisons (e.g., to more easily evaluate new algorithms, and/or quantify data and product uncertainty).
- Tools to broaden the applicability and reduce the cost of simulations (e.g., Observing System Simulation Experiment, OSSE) for evaluating instrument, mission, sensor networks, and field campaigns.

Additionally, proposals are sought for the development of quantum annealing/computing algorithms for Earth sciences. Selected proposals will be given access to the NASA quantum annealing system located at the NASA Ames Research Center (see http://www.nas.nasa.gov/projects/quantum.html). Proposals must address Earth science problems that are suitable for solving via quantum optimization algorithms, such as clustering for pattern recognition, data fusion and image matching for remote sensing, structured learning for multiple label classification, and others. Successful proposals need

to describe the full cycle of research on the quantum system. This includes (1) the identification of the specific application embodying an optimization problem, (2) the strategy for mapping the problem into the quadratic unconstrained binary optimization (QUBO) format, and (3) the strategy for embedding the QUBO into the underlying Chimera graph of qubits of the quantum device.

2.1.3 Data-Centric Technologies

Data-centric technologies are those that broadly support the science and applications communities in conducting the sequence of activities needed to transform Earth science observational data from NASA missions, model output and other related datasets to improve information re-use, facilitate collaboration within the research community, and increase the speed with which results are produced and published. These technology development areas include design of novel and innovative technologies that advance the discovery, access, and use of NASA's Earth Science data within rapidly developing community architectures (e.g., the Global Change Information System and the Climate Data Initiative) and global architectures (e.g., the Internet of Things, Smart Cities, and Smart World). They also yield data products that advance beneficial and expeditious Earth science research and resulting publications and aid decision-making within the research and application communities.

The scope of data-centric technologies includes, but is not limited to, the following sample technology areas:

- Big data analytics applied to the substantial data and metadata that result from Earth science observations and the use of other data-centric technologies, along with tools and techniques for data fusion and data mining.
- Software architectures and frameworks that support the incorporation of scaling, models, data, sensor webs, data mining algorithms, and visualization by leveraging and/or enhancing interoperability standards.
- Tools and techniques to ease the incorporation of data quality, provenance, semantics, and any relevant metadata into Earth observation data. Capabilities to implement, discover, and consolidate/integrate shared services for effective use and management of data and metadata in the science and applications communities (e.g., data provenance mechanisms, uncertainty quantification methods, data quality metrics).
- Storage, management, and processing techniques for large data volumes (e.g., cloud computing, data distribution services and service migration) and for reducing end product latency to enable near-real time delivery.
- New and/or enhanced customized tools for managing the development, reuse, and evolution of large scientific codes (e.g., enhancements to open source tools).
- Tools to enable software applications to execute functions then autonomously share results with one another, without compromising system security or violating associated data policies.
- Technologies that provide opportunities for more efficient interoperations with the observations data systems, such as high end computing and modeling systems.
- Capabilities that advance integrated Earth science missions by enabling discovery and access to Service Oriented Architecture (SOA) components and services.

2.2 Special Subtopics

For this solicitation the AIST program is working closely with each of the Earth Science functions (R&A, Flight, and Applied Sciences) by designating special subtopics to help address their longer-term needs. Offerors are invited to submit proposals that offer novel, higher risk/return approaches to the stated challenges.

2.2.1 Innovation Breakthroughs for Modeling, Analysis, and Prediction

Advanced information technology is prevalent across Earth Science R&A activities and is both an enabler and a major cost driver in supporting scientific breakthroughs. Presently there are substantial investments in information technologies to support important climate and weather numerical modeling and related data analysis activities across the Agency. In recent years these investments have been targeted at establishing more open, collaborative working environments to enable more comprehensive Earth system science in which models, model components, and data are more easily exchanged. They have also been targeted at managing exponential growth in data volumes and improving the ability to share data within the Earth science community.

This solicitation seeks innovation breakthroughs to further such capabilities through advanced software frameworks (either in support of existing frameworks or to propose new ones), development of new tools to use NASA Earth science data for model validation, and enhancing capabilities for accessing and operating on climate and weather model output. Proposed outcomes should demonstrably improve the efficiency of the process of using models or model output for research (i.e., reduce the time and effort needed between accessing the science data or generating the model output to publishing the research paper). Potential breakthroughs may be linked to (but are not limited to) the following:

- Developing advanced computational workflows that reduce the time and effort for new users to build a variety of model configurations.
- Developing techniques to capture the necessary provenance (e.g., model execution configurations) for sharing experiments with other investigators.
- Hosting models and/or related analytical tools as web services, thus eliminating the need for porting tools to non-native platforms.
- Use of Integrated Development Environments.
- Re-engineering efforts (e.g., refactoring) of legacy codes to improve reusability.
- Developing or enhancing the use of state-of-the-art software engineering practices aimed at reducing coding errors.
- Implementing software standards that help advance the vision of a national software infrastructure for climate modeling as articulated in the NRC's report *A National Strategy for Advancing Climate Modeling*[7].

Proposers should note that the Computational Modeling and Cyberinfrastructure (CMAC) program (NASA ROSES element A.40) has solicited similar technologies in the past, however this solicitation seeks lower TRL, higher risk proposals than for typical CMAC projects.

[7] http://www.nap.edu/catalog.php?record_id=13430

2.2.2 Alternative Approaches / Disruptive Technologies for Earth Science Data Systems

The collection, production, archival, and distribution of the voluminous stores of Earth Science data products is a core capability provided by the Flight function. The Earth Observing System Data and Information System (EOSDIS) program provides the end-to-end capabilities for managing NASA's Earth Science data from satellites and aircraft. In support of these activities this solicitation seeks long-term solutions that will allow more seamless access to Earth Science data in the exascale-computing era.

NASA Earth science data archives hold many petabytes of structurally and scientifically complex data. At present the ability to mine, analyze, and query these data in a comprehensive way is challenged by the exponential growth of the data repositories. Typically, users must have access to significant institutional infrastructure to conduct large-scale analysis. Technologies developed for this solicitation should help reduce the need for a user to directly download large amounts of data and/or support a large computational infrastructure in order to have the ability to conduct such comprehensive analyses and data mining. Technologies include, but are not limited to:

- Architectures, techniques, and algorithms to allow a user to avoid costly transmission of large data stores and to dynamically optimize performance and resource utilization for a given computational task.
- Alternative data structures (i.e., beyond granules) or storage techniques and methodologies that facilitate high performance bulk downloading, data mining, analysis, and user-defined aggregation.
- Strategies, techniques, and architectures that would allow a user to remotely assemble high performance computational or analytical workflows in an elastic resource environment.

NASA, through the Earth Science Data Systems Working Groups (ESDSWG) and also with interagency cooperation through the Federation of Earth Science Information Partners (ESIPFed), has been researching and experimenting with semantic web technologies for many years. As the Semantic Web has matured, very broad, general ontologies have emerged in the community. Several specific NASA funded projects have also developed application-focused ontologies. Technologies developed for this solicitation will provide the "middle layer," including developing and applying domain level ontologies with the potential to go beyond a single project or application, increasing the interoperability and usability of semantically identified information in support of Earth Science. This solicitation also seeks technologies to explore, visualize and analyze representations of semantically identified information to discover new useful information.

- Semantic ontologies, particularly domain level ontologies, for the interoperable expression of information.
- Semantic analytics, i.e., methods for analyzing and mining information expressed semantically to discover and/or predict behaviors and anomalies.

Approaches that are disruptive to current techniques are welcome, however any idea proposed must support the overarching goals of the EOSDIS program (http://earthdata.nasa.gov/esdis).

2.2.3 Technology Enhancements for Applied Sciences Applications

Proposals are sought that develop new and potentially "game changing" capabilities for decision support or end user applications through the use of Earth Science data and/or models in one of the Applied Sciences active applications themes[8]: 1) Health and Air Quality, 2) Disasters, 3) Water Resources, and 4) Ecological Forecasting. Technology development activities in this topic area must target a public or private sector organization considered to be a value-adding entity or an end-user of NASA Applied Sciences data and services, and at least one member of the proposal team must be from this organization. A letter of endorsement supporting the technology development is required from the identified organization end user. Proposers who are targeting the Disasters application theme should reference *GEOSS Architecture for the Use of Remote Sensing Products in Disaster Management and Risk Assessment*[9], a report issued by the Committee on Earth Observation Satellites - Working Group on Information Systems and Services (CEOS-WGISS). This document should be used when describing the activities and rationale for the proposed technology.

3. Proposal Content and Submission

Proposers are advised to periodically check the solicitation website (http://nspires.nasaprs.com/) for any amendments to the ROSES-2014 NASA Research Announcement (NRA), and consult the NRA *Guidebook for Proposers*[10] (2013 edition, hereafter referred to as "the Guidebook") for important information in responding to the solicitation.

Notices of Intent (NOI) to propose are encouraged but not required (refer to section 6 for the due date). Please refer to the *Guidebook* for more information regarding NOIs.

The required proposal contents follow the format prescribed in the *Guidebook*, section 2.3, except in the case where additional information is needed to supplement this solicitation. Those additional requirements are highlighted below.

Required Proposal Section	***Guidebook* Reference**
Proposal Cover Page	2.3.2(a),(b)
Proposal Summary (abstract)	2.3.3
Table of Contents	2.3.4
Scientific / Technical / Management • Applicability to NASA Earth Science (Relevancy Scenario) • Description of Proposed Technology	2.3.5 and additional elements (see

[8] Applied Sciences themes represent a subset of the US Group on Earth Observations Societal Benefit Areas, which are Agriculture, Climate, Disasters, Ecological Forecasting, Energy, Health, Oceans, Water Resources, and Weather.

[9] http://www.ceos.org/images/Disasters/GA.4.D_v1.0.pdf

[10] http://www.hq.nasa.gov/office/procurement/nraguidebook/proposer2013.pdf

• Comparative Technology Assessment • TRL Assessment • Research Management Plan	important note below)
References and Citations	2.3.6
Biographical Sketch	2.3.7
Current and Pending Support	2.3.8
Statements of Commitment and Letters of Support	2.3.9
Budget Justification – Narrative Details	2.3.10

Please note the Scientific / Technical / Management Section (2.3.5) is customized for this solicitation as follows:

Scientific / Technical / Management Section (this section is specific to this NRA and replaces Section 2.3.5 of the Guidebook)*:* The material submitted in this section must be constrained to 15 pages and follow the Standard Proposal Style Formats as specified in the *Guidebook.* For this solicitation the following five subsections are required to be included and clearly identified in the Scientific / Technical / Management section.

a) Applicability to NASA Earth Science: Relevancy Scenario. In no more than one page, the offerors should provide a relevancy scenario (i.e., use case) that describes how the proposed technology will benefit NASA Earth Science and how the work links to the elements of the strategic planning documents mentioned above, and as appropriate, to the special topics in section 2.2. The relevancy scenario is intended to sell the concept being offered and should provide clear examples of how the technology would be infused or integrated (i.e., if the technology is targeted at a flight program the applicable NASA mission or measurement should be identified). Involvement of Earth science researchers in advancing these concepts is highly encouraged. Proposals that fail to include a relevancy scenario may be rated significantly lower.

b) Description of Proposed Technology. Provide a description of the proposed element, system, or subsystem technology. Describe the technical approach and include an operational concept of the proposed technology that addresses Earth science needs. Discuss any possible cross-cutting or commercial benefits.

c) Comparative Technology Assessment. Describe the anticipated advantages of this element, system, or subsystem technology compared to those currently in use, e.g., reduction of size, mass, power, volume or cost, improved performance, or enabling of a new capability not previously possible. Review the current state of the art and relate it to the proposed work.

d) TRL Assessment. Provide the current TRL assessment of the technology and the anticipated progression of TRL levels throughout the proposed effort based on the NASA software or hardware TRL definitions. Note that ESTO desires the TRL to advance by at least one during the two years of performance of the activity. For this solicitation, the entry TRL is expected to be from 2 through 5. The proposer should clearly identify the entry TRL, the planned exit TRL, and success criteria in their proposal. Past and ongoing work on the research activity should help to determine the entry TRL.

e) Research Management Plan. The offerors should provide a statement of work that concisely describes each task or milestone and duration for each that will be accomplished in the course of the research and development. The Statement of Work should explicitly define the success criteria associated with each task or milestone. Also include a milestone schedule chart that identifies critical milestones. At least two milestones per 12-month period should be defined. Subcontracting portions of the research project is acceptable and is the responsibility of the proposing organization to manage and include in reporting.

4. Evaluation Information

For this solicitation, the following important factors are included in the evaluation process (relevance, intrinsic merit, cost realism/reasonableness) and replace those given in the *Guidebook* Appendix C.2.
The first criterion, relevance to NASA's objectives, includes the applicability of the proposed investigation to Earth science missions and technology needs (one third of total evaluation weight) and specifically includes the following factors:

a) The proposal's relevance and potential contribution to NASA's scientific and technical areas of emphasis, including the potential to enable new information products and/or measurements which are part of the NASA Earth Science needs.

b) The potential for the technology development to reduce the risk, cost, size, and development time of Earth science systems. Potential cost reductions should be clearly stated and substantiated to the extent possible, with supporting analysis that indicates scalability.

c) The potential of the technology to be integrated, once matured, into an Earth science mission, research activity, or a product for use by the Applied Sciences function.

d) The potential for the technology to have commercial benefits.

The second criterion, intrinsic merit, includes the technical merit of the proposed investigation (one third of total evaluation weight) and specifically includes the following factors:

a) Feasibility and merit of the proposed technical approach to achieve the technology development objectives.

b) Degree of innovation of the proposed study or technology development concepts and approach.

c) Past performance and related experience in the proposed area of technology development.

d) Qualifications of key personnel, and adequacy of facilities, staff, and equipment to support the proposed activity as it contributed to cost realism.

e) Substantiated justification and appropriateness of the entry and exit TRL. For this solicitation, the entry TRL is constrained to be between 2 and 5 inclusive, with the exit TRL no higher than 7.

f) Feasibility of obtaining the potential reduction in risk, cost, size, and development time with the proposed technology, and the feasibility of making a demonstrable TRL increase of at least one level during the performance period.

The third criterion, cost realism and reasonableness (one third of total evaluation weight) specifically includes the following factors:

a) Adequacy and realism of proposed milestones and associated success criteria.

b) Realism and reasonableness of the proposed cost and comparison of costs to available program funds.

c) Adherence to sound and consistent management practices appropriate to the TRL level of the proposed task.

d) Commitment of the organization's management to the proposed technology development (evidenced by cost and resource sharing, prior teaming arrangements, etc.). Proposers should identify any previous investment by the organization/program and provide supporting documentation.

5. Technical Reporting Requirements

Proposers should be aware that technology programs require more extensive reporting than many other ROSES elements and these costs should taken into account in submitted proposals. Following an award the PI is expected to consult with the AIST program manager to refine the statement of work, milestone schedule, cost plan, create a project quad chart, and other tracking elements that will be used during the period of performance. Material associated with deliverables will be submitted to ESTO's electronic document repository (agency IT security requirements require PIs to register with NASA's Identity Management and Account Exchange system).

Quarterly Technical Notes: These are brief comments that summarize accomplishments for the preceding three months and any notable changes to technical status, schedule, or cost (the Quarterly Note is superseded if Interim, Annual, or Final Reports are due coincidentally).

Interim Reviews: These are hour-long oral presentations conducted via videoconference at the end of the first 6-month calendar period, commencing from the start date of award and at 12-month intervals thereafter. The PI is also asked to provide an editable version of the presentation that addresses elements required by ESTO, such as milestone schedule status, primary findings, technical status, results of tests, work planned for the remainder of the project, risk items, and data regarding obligation and costing of funds. Additionally, the PI should report on educational and outreach components of the project, technology infusion or patents, journal or conference publications, presentations at professional conferences, media exposure, or any other activities that contributed to the project.

Annual Reviews: These two-hour-long oral presentations are typically held at the PI's facility or via videoconference and include attendance from an independent technical reviewer. In addition to the elements required by the Interim Review, the Annual Review is more comprehensive and may also include live demonstrations or other types of presentations to articulate progress made on the effort. The last Annual Review is termed the "Final Review" and necessitates a summary of the overall effort against success criteria. A detailed written report is also required at the conclusion of the project.

Forums and Meetings*:* The awardee is encouraged to participate in relevant technology forums and other conferences and meetings related to Earth Sciences (please note there are limited slots available for NASA civil servant and contractor personnel for such events). Offerors must include travel costs in their proposals. The awardee should be prepared to make a presentation, provide a paper, or create a poster providing a description of the project, the objectives, approach, technical status, and schedule information.

PIs or their representatives are also expected to participate in ESTO Earth science information systems technical meetings to advance information sharing on components and concepts. Follow-on efforts are envisioned to identify candidate Earth science scenarios that will benefit from information systems technology concepts, and approaches and that can be prototyped to demonstrate those benefits through collaboration and science participation.

6. Summary of Key Information

Expected program budget for first year of new awards	~ $12.5 million
Number of new awards pending adequate proposals of merit	~ 18-24
Maximum duration of awards	2 years
Due Date for Notice of Intent to Propose (NOI)	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Due date for delivery of proposals	See Tables 2 and 3 in the *ROSES Summary of Solicitation*.
Planning date for start of investigation	9 months after proposal due date.
Page length for the central Science-Technical-Management section of proposal	15 non-reduced single-spaced typewritten pages; see also Chapter 2 of the *NASA Guidebook for Proposers*.
Relevance to NASA	This program is relevant to the Earth Science questions and goals in the NASA Science Plan; see Table 1 of ROSES and the reference therein. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the *ROSES Summary of Solicitation*.
Detailed instructions for the preparation and submission of proposals	See the *NASA Guidebook for Proposers* at http://www.hq.nasa.gov/office/procurement/nraguidebook/.
Submission medium	Electronic proposal submission is required; no hard copy is required or permitted. See also Section IV of the *ROSES Summary of Solicitation* and Chapter 3 of the *NASA Guideline for Proposers.*

Web site for submission of proposal via NSPIRES	http://nspires.nasaprs.com/ (help desk available at nspires-help@nasaprs.com or (202) 479-9376)
Web site for submission of proposals via Grants.gov	http://grants.gov (help desk available at support@grants.gov or (800) 518-4726)
Funding opportunity number for downloading an application package from Grants.gov	NNH14ZDA001N-AIST
NASA point of contact concerning this program	Karen Moe Earth Science Technology Office Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 E-mail: Karen.Moe@nasa.gov